# United States Patent

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## [54] METHOD OF THE ELECTROSLAG REMELTING OF CONSUMABLE ELECTRODES


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[58] **Field of Search** ..... 164/52, 252



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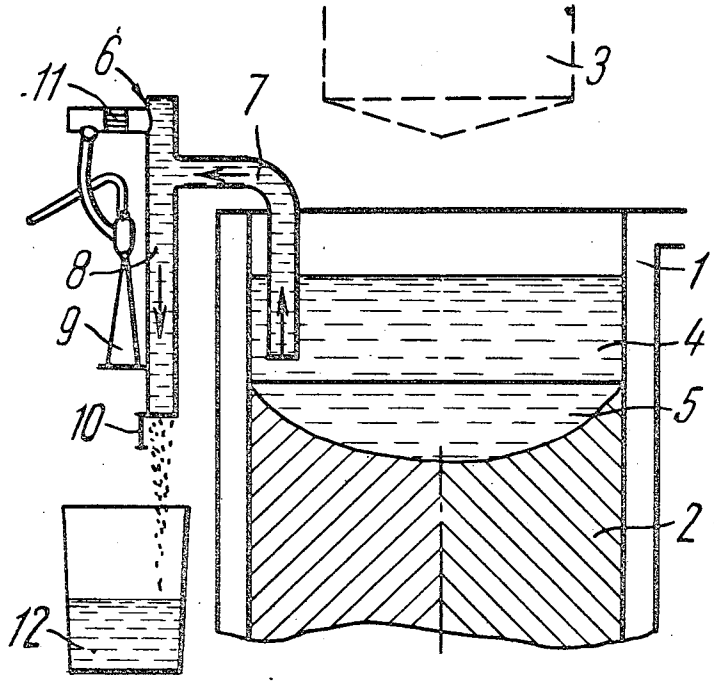
[57] **ABSTRACT**

A method for the electroslag remelting of consumable electrodes in a cooled mould which involves the building-up of the ingot of the requisite length, following which the consumable electrodes are de-energized and withdrawn from the molten slag. The exterior of the deposited ingot is freed from the liquid slag, which can be removed either by scooping or by flusing or, finally, by forcing it out by dipping in discarded metal. The liquid slag may be also removed with the aid of a siphon appliance.


**4 Claims, 1 Drawing Figure**



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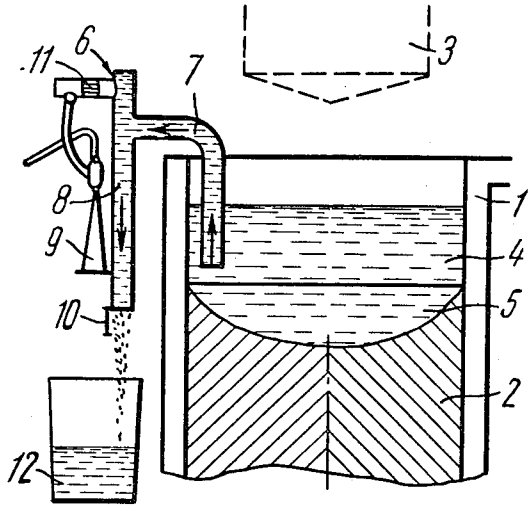

# METHOD OF THE ELECTROSLAG REMELTING OF CONSUMABLE ELECTRODES

The present invention relates to a method for electroslag remelting of consumable electrodes in a cooled mould.

Known in the prior art are methods for the electroslag remelting of the consumable electrodes in cooled moulds, which consist in building-up the ingot of the requisite length, switching off the consumable electrodes from a power supply and their removal from a slag bath. Following this the ingot is cooled by holding it in the cooled mould until both the metal and the slag on the upper portion of the ingot solidify completely.

Heavy ingots should be kept in moulds for 4 to 8 hrs for cooling.

The subsequent detachment of solidified slag from the ingot is a laborious operation which requires additional time and facilities.

In particular, with ingots of 10*t* in weight and over, the problems are considerable, as regards their volume, metal and slag baths. As metal is characterized by a higher, heat conductance when compared with slag, solidification of the metal bath, on completion of the electroslag remelting of consumable electrodes, occurs at a substantially higher rate than solidification of the slag bath. In such a case the length of time during which the ingot is held in a mould is determined not by the solidification time of the ingot liquid metal, but by the crystallization time of the liquid slag.

Thus, for instance, after building-up a 15-*t* ingot by the application of the electroslag remelting technique, one hour is sufficient for crystallization of the liquid metal, while solidification of the slag located above the metal requires over 3.5 hr. If the ingot is extracted before the specified interval, the liquid slag can break through the slag skin and cause a failure.

Consequently, the current technology of the electroslag remelting of consumable electrodes for producing heavy-tonnage ingots involves idle time amounting to several hours per melting.

In addition, continuous cooling of an ingot in a mould addersely affects the quality of metal, particularly in the bottom portion of the ingot. In remelting steels, prone to hardening, it may lead to the occurrence of cold cracks in the ingot.

It is an object of the present invention to eliminate the above difficulties.

The present invention is, in essence, aimed at developing a method for the electroslag remelting of consumable electrodes which would make it possible to accelerate the process of production of metal ingots and to enhance their quality by reducing idle time.

According to the present invention, this object is achieved by providing a procedure for the electroslag remelting of consumable electrode in a cooled mould by using electrical energy, involving the building-up of the ingot of the requisite length following which the consumable electrodes are first deenergized and then the liquid slag is removed from the ingot head.

This results in a substantial reduction in the holding time during which the ingot is left in the mould for cooling.

In order to remove the liquid slag from the ingot head use may be made of a siphon, or the slag can be scooped or, as a further alternative may be forced out by dipping into it the expanded portion of the electrode discarded metal. This would allow the method of the invention to be accomplished in the most simple way.



To make the principle of the present invention more fully apparent outlined below is an exemplary embodiment of the proposed procedure to be considered in conjunction with the accompanying drawing which diagrammatically illustrates a vertical longitudinal section through a siphon appliance for the removal of slag from a mould.

In conformity with the present invention the procedure for the electroslag remelting of consumable electrodes may be impletented as follows: The charging of synthetic flux into mould **1** as well as the building-up of ingot **2** is carried out according to known technology adopted for the electroslag remelting of at least one consumable electrode **3**. After ingot **2** has been built-up to the requisite length, consumable electrodes **3** are isolated (illustrated in the drawing is only one electrode) from the power source (not shown in the drawing) and withdrawn from liquid slag **4**. Next the major portion of molten slag **4** is removed (displaced, scooped or slagged off) from the exterior of ingot **2** which is being cooled in mould **1**. Crystallization of the remaining thin layer of slag **4** would occur comparatively rapidly, almost at the same rate as metal bath **5**.

Molten slag **4** may be disposed through the utilization of siphon appliance **6** fitted with two branch-pipes: branch **7** to be immersed in liquid slag **4** and branch-pipe **8** arranged on the exterior of mould **1** and designed for draining molten slag **4**.

Siphon appliance **6** incorporates an evacuator **9** for evacuating the said branch-pipes, plug **10** for shutting off branch-pipe **8** and drilled sleeve **11**, whose object is to keep the passage in evacuator **9** from being cloged by entrained slag.

By using the above siphon appliance molten slag **4** is drained as follows.

Branch-pipe **7** of siphon appliance **6** is submerged in molten slag **4** so that it does not touch liquid metal **5** in the upper portion of ingot **2**. Thereupon vacuum is created in branch-pipes **7** and **8** with the aid of the evacuator **9** with branch-pipe **8** being closed by plug **10**. As a result the liquid slag enters branch-pipes **7** and **8**, fills them and, as soon as plug **10** is open, drains into slag pot **12**.

In other exemplary embodiments, conforming to the method of the invention, the slag can be either scooped or forced out by submerging in it the electrode discarded metal with its expanded portion down. If it is the case the mould is fitted with a tap hole and a spout.

What is claimed is:

1. A method for electroslag remelting of consumable electrodes to form an ingot in a cooled mould, comprising the operations of: arranging at least one consumable electrode to dip in a cooled mould and connecting the electrode to an electrical power source to strike an arc at the electrode bottom end to melt down the electrode material; feeding a required amount of flux into the mould at the arc region, which results in formation of molten slag; building up a required length of ingot under the molten slag; de-energizing the consumable electrodes; and removing the molten slag from above the formed ingot so as to shorten the cooling time and the time lag after which the formed ingot may be taken out of the mould.

2. A method, as claimed in claim 1 in which said step of removing molten slag comprises removal thereof by a siphon appliance.

3. A method, as claimed in claim 1 in which said step of removing molten slag comprises scooping the slag from the ingot head.



4. A method, as claimed in claim 1, in which said step of removing molten slag comprises forcing out the slag from the ingot head by immersing into it an expanded portion of an electrode discarded metal.

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